University of Washington

ARBORETUM BULLETIN

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Arboretum Foundation Membership Message

How does one emphasize the importance of Membership in a Foundation? For an inspiration I looked in Webster's Dictionary. It defined membership as "the body of members," which seemed appropriate. What about Foundation? Again, Webster provided not one, but two definitions which seemed to fit: "the basis upon which something stands or is supported," and, "funds given for the permanent support of an institution."

The Arboretum Foundation needs more of both—the body of members and funds for permanent support of the Arboretum. Our body of members has been declining steadily over the past several years. An audit of our membership records for the period from May 1 to December 31, 1983, disclosed an enrollment of 143 new members, and a reinstatement of 137 who had allowed their membership to lapse for three months or more. These numbers were not sufficient to offset 470 members who had to be dropped for nonpayment of dues or other causes. The result has been a net loss of 195 members in the eight month period, for a total membership of 2,267. The additional billings (three for each member dropped) caused by lapsed memberships cost additional postage and clerical time which the Foundation can ill afford. Please send in your dues promptly when you receive a notice to renew your membership.

Needless to say, loss of membership has resulted in a proportionate loss of income. We have been fortunate to have had currently a cushion provided by unrestricted interest income, but this cushion soon will be reduced when construction begins on our long-hoped-for Visitors' Center. The Foundation Board has been reluctant to change or increase our dues structure. Many of our ardent supporters have reached the age of 65 and over, and have taken advantage of our senior membership because of their reduced income. Accordingly, we ask that where possible our members increase their annual membership contributions.

In summary, we need to keep the members we have and to increase the number of new members. It is not only essential financially to have a large membership, but it is politically important to show that the Foundation has wide popular support in its programs to serve the Arboretum. We believe that the programs we have in place and those we propose to initiate will increase our membership, but not without the full assistance and cooperation of all of our members.

"EVERY MEMBER GET A NEW MEMBER"

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Tree of canyon maple *(Acer grandidentatum)*
in fall color of scarlet
near Alpine, Lincoln County, Wyoming, 6200 feet.

Photo: Brian O. Mulligan

The ring-tailed lemur exhibit at Woodland Park Zoo depicts the relationship between animals and the plant life upon which their lives depend. Note how careful exhibit construction makes it virtually impossible to ascertain that the animals are actually contained. **Photo: A. Gorski**

It's A Jungle Out There—Almost
The Role of Vegetation in Zoo Animal Exhibits

*ANDREW F. GORSKI**

Author's Note: The natural habitats of animals can be simulated in zoos. Such naturalistic exhibits are increasingly understood to serve several purposes. They can provide visitors with a positive educational experience while supplying animals with physically and psychologically supportive environments. The inclusion of a plant community physically and ecologically similar to that found with animals in their natural habitats is a strong complement to the design of an exhibit as a whole. Outstanding examples of naturalistic exhibits are found at Seattle's Woodland Park Zoological Gardens and the Point Defiance Zoo and Aquarium in Tacoma, Washington.

This article is based on a paper presented at the 1983 combined annual meetings of the American Association of Botanical Gardens and Arboreta and the Association of Zoo Horticulture held at the San Diego Wild Animal Park. The original paper will appear in the BULLETIN of the AABGA in 1984.

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*Andrew Gorski, graduate student in the Center for Urban Horticulture, has long been interested in the educational responsibilities of public gardens and zoos. He feels that a contemporary challenge for such institutions is to promote a public understanding and appreciation for threatened natural systems.

Introduction

An understanding of beauty in nature is relevant to a recognition of subtle variations in pattern—variations on a theme. Consider the structural pattern in the shell of a chambered nautilus. Although all internal compartments are similar, each is unique. Likewise, the spotted coat of a fawn and the leaves of a Japanese maple are beautiful because the combination of similar yet distinct elements creates a pattern with variations.

There are even larger themes in nature—recognizable patterns in the relationship between plants and animals, and between living things and their environments. The fawn's coat for example is even more beautiful when one considers its adaptive function for camouflage. An appreciation of patterns in nature is fundamental to the management and preservation of our natural heritage. For the general public, where else can this perception be gained better than at our living museums: zoos and public gardens?

Zoos of the Future

For a moment, it is interesting to consider some distinctions between zoos and display gardens. Both types of institution are involved in the display, study and conservation of living organisms. However, these organisms (animals and plants) represent entirely different trophic levels. Plants initiate the food chain and in many ways are self sufficient. For educational purposes in gardens, plants can be accurately displayed in aesthetic, taxonomic, and ecological groupings or even as isolated specimens. Animals, however, represent trophic levels directly or indirectly dependent upon plant life. Their lives cannot be accurately displayed in settings with no representation of the vegetation upon which they depend.

Even our perceptions of plants and animals distinguish these two types of organisms. Imagine your very different reactions if you entered a room in which there was nothing but a cactus or a room which was occupied by a porcupine. Both organisms could potentially inflict pain, but the active part the animal plays results in a perceptual distinction. If placed in a situation where there is no physical barrier between a wild animal and ourself, we can be fascinated by the potential for interaction but fearful of the possibility of being harmed.

The emphasis in many zoos is on the exhibition of animals whose behavioral motivations, levels of intelligence and natural instincts are relatively unknown to us. Consequently, a long tradition in their exhibition has been the inclusion of an obvious barrier separating the viewer from the animals. While this relieves us of natural fears it can also create a vast psychological distance between ourselves and the animals.

Another tradition has been the confinement of animals in close quarters constructed primarily of artificial materials. An unfortunate result of such environments can be psychological stresses imposed on the animals made evident in pacing and other forms of aberrant social behavior.

Consider an example of a snow leopard contained in a concrete and steel cage. The viewer is permitted a physically close inspection of the handsome animal but there is little sense gained of the part this creature plays in a community of living things. The pattern of markings on the leopard's coat may be perceived as beautiful, but its importance as camouflage in the natural environment remains unseen. The overpowering realization is that humans are the animal's

The creation of a complex natural habitat for squirrel monkeys at Woodland Park Zoo supplies the animals with the option of being out of public view. It is thought this animal choice relieves some of the stresses of captivity. Note the monkey near the base of the largest upright tree.

Photo: A. Gorski

masters. We may feel pity for the creature's inability to relate to it surroundings, guilt for being remotely responsible, and frustration at our inability to change the situation. I make the optimistic statement that these emotions, which I certainly felt as a child viewing caged animals, are a thing of the past. This is, of course, dependent upon our ability to design and construct naturalistic exhibits where an animal is perceived in the context of its natural surroundings.

Sterile glass, steel and tile enclosures, remnants of past exhibit philosophies, are rightfully challenged. In the face of rapid rates of animal extinction and loss of natural habitat, there has never been a time in which a public understanding of the web of life has been more crucial. Zoo administrators and designers realize that the experience of visitors must be a positive one so that concern for the preservation of the biotic community will result.

There is a need for zoos to become a new type of botanical garden, in reality a zoological garden, where plant collections help to simulate natural animal habitats. As a result, not only will both plants and animals be on display, but also the patterns in the relationships between them.

Pacific Northwest Zoos

The Pacific Northwest is blessed with seemingly unlimited natural beauty. Realizing the value of this recreational and aesthetic resource, it is not surprising that the people of the region have developed an acute environmental awareness. As a result, the Puget Sound basin has nurtured zoos in which naturalistic exhibits have become the standard. Excellent examples can be found in both Seattle's Woodland Park Zoological Gardens and the Point Defiance Zoo and Aquarium in Tacoma, Washington. In both cities, passage of park bond issues has supplied existing municipal zoos with millions of dollars for renovation and the construction of new facilities.

An intellectual and financial climate favoring qualitatively better zoos would have been wasted, however, in the absence of a few insightful and creative individuals. In this light, a fortuitous association has been that of Grant Jones, head of the architectural and landscape architectural firm of Jones and Jones in Seattle, and David Hancocks, former Director of the Woodland Park Zoo.[1] The resulting renovation of Woodland Park has been a progressive approach to zoo design which Jones and Jones has since carried to many parts of the country.

Since 1976, large areas of Woodland Park Zoo have been renovated following a foresightful long-range plan authored by Grant Jones, his partner Jon Coe, and Dr. Dennis Paulson of the

[1] David Hancocks, who transformed the Woodland Park Zoo into an internationally recognized institution, resigned from directorship in December of 1983. His primary concern was the recent defeat of parks bond issues and a general lack of public financial support for the Zoo.

The Savannah Overlook at Woodland Park Zoo has been planted with a plant community very similar to that found within the savannah exhibit. For the public, this creates a visual orientation to the upcoming exhibit. Note the grasses growing on the roof of the structure. **Photo: A. Gorski**

Zebra and giraffe are only some of the hoofed creatures that enjoy the open space of the African Savannah.
Photo: A. Gorski

Burke Museum at the University of Washington. Ultimately, ten bioclimatic life zones ranging from the tropical forest to the arctic tundra will be constructed.

Each life zone has been located within the zoo with regard to existing microenvironmental conditions of terrain, soil, aspect, vegetation and hydrology. Existing structures and utilities have also played a practical role in the layout. Through a process of thorough inventory and overlay mapping of individual site conditions, areas potentially most suitable for the construction of a particular zone were identified. The "lay of the land" revealed its own opportunities and constraints. For example, the African Savannah was constructed within a large expanse of open, sunny terrain occupied by a few widely spaced trees with spreading canopies.

Animal exhibits at Woodland Park were planned with the precepts of sociobiology in mind: exhibits consist of animals in social groups of natural size with a vegetative community simulating that found in the animal's natural habitat. Thus, in designing the gorilla exhibit, a simulated West African tropical jungle is the home for a growing family of gorillas. In this way, the animals are offered a physically and psychologically healthy environment while visitors enjoy a view of animals in naturalistic surroundings. This approach focusses on the quality of individual exhibits and not on the overall variety of animals displayed in the zoo.

In the renovation of the Point Defiance Zoo and Aquarium, Jones and Jones also stressed the replication of natural habitats. An interpretive theme (eventually to be adopted throughout the zoo) emphasizes patterns in animal adaptation to their habitats. Because the facility is both a zoo and an aquarium, there is a focus on the display of marine, terrestrial and fresh water organisms associated with the great rim of the Pacific Ocean. "The Pacific Rim Geographic Realm" theme determines the spatial arrangement of exhibits.

In the design of naturalistic zoo exhibits, Jones and Jones has been a pioneer in the use of several techniques which have earned national recognition for the firm. Extensive research into the habitats of animals has allowed for accurate simulation of topographic and vegetative details. Skillful replication of rocky outcroppings, exposed soil profiles, and plant community structure and composition portray natural scenes which belie the intensive

Home for the gorillas at Woodland Park Zoo is a naturalistic exhibit simulating the animal's native habitat in West Africa. Such naturalistic exhibits can supply animals with physically and psychologically supportive environments.

Photo: A. Gorski

design effort which has gone into them. For the casual observer, the effects are simply natural, but to the astute eye, the evidence of attention paid to detail is striking.

It is virtually impossible to duplicate in one place the natural vegetation of many distant continents and different climatic zones. The problems of plant hardiness and availability alone can be insurmountable. However, if the landscape architect or consulting horticulturist has a good sense of the visual character of the desired plant community and of the individual plants therein, locally available material can be used to simulate those qualities. Naturally, attention must be paid to the avoidance of plants toxic to animals.

There are many horticultural challenges to growing plants in the presence of high concentrations of potentially destructive animals. As Becca Hanson (formerly of Jones and Jones) relates, meeting these challenges is frequently a matter of adapting known horticultural practices to new situations. For example, the soil compaction problems associated with a hoofed-animal exhibit are similar to those of a soccer field. Consequently, construction techniques for athletic fields have been adapted to encourage establishment of grasses at the zoo.

A great deal of what is now known in zoo horticulture has been learned by experimentation. At Woodland Park, it is not considered unreasonable to replace a plant in an exhibit three times before giving up on the use of plant material in a particular location. Designers have realized, however, that a solitary specimen may more likely be the focus of an animal attack than a group of plants. Additionally, it is frequently crucial to allow a newly planted exhibit to establish itself for as much as a year prior to the introduction of animals.

Plants used in an exhibit need not be confined solely to the inside of that exhibit, for an extension of the exhibit plant community into the public zone can create a visual orientation to upcoming exhibits. An excellent example exists in the gorilla exhibit at Woodland Park where viewers are surrounded by plants simulating a West African tropical forest. Immersed in the same vegetation as the animals, the visitor feels a certain association with the scene. Such landscapes have been criticized as looking weedy, but this perception is easily handled by educational signs which interpret the vegetation.

In order to stimulate our curiosity, and even a romantic sense of fear, visual barriers between animals and visitors should be unseen wherever possible. The lion exhibit at Woodland Park is an example where the use of land forms in the careful construction of views has hidden fences and moats. From any given vantage point, it is virtually impossible to ascertain that the lions are really contained.

A fundamental element of good exhibit design is to allow viewers to view animals only at or above human eye level. Exhibits of the past, where the viewer looked down onto animals, can provide a psychologically stressful environment for the animals. In the new snow leopard exhibit at Woodland Park, Thomas Berger, a Seattle landscape architect, has replicated a

Himalayan mountain slope on which the leopards are viewed from a simulated rhododendron lowland.

Another way to relieve some of the stresses of captivity is to allow animals the option of being completely out of view. Exhibits designed allowing for this animal choice have been criticized for their inability to offer paying visitors a guaranteed sighting of the animals, but Zoo administrators feel that health benefits for the animals outweigh this disadvantage.

Conclusion

Naturalistic zoo exhibits can indeed serve several purposes, not only providing animals with healthy environments. but also offering visitors a positive educational experience. The construction and care of these exhibits, however, require a sophisticated horticulture incorporating a working understanding of the goals of natural habitat simulation. The result will be a strong contribution toward meeting the contemporary educational challenges of zoos.

Zoo designers face a difficult task. In order to paint a complete picture of animals and all the living and non-living things upon which their lives depend, the earth itself would have to be replicated. Alas, there are real world financial and technical limitations in the design of our zoos. Fortunately, an association of natural scientists and skilled designers can result in exhibits where creatures from our planet are no longer perceived as aliens caught in space and time, but as friends worthy of our respect and protection.

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In the Tropical Forest Island Complex at Woodland Park Zoo, vegetation morphology and soil and rock outcroppings simulate natural conditions found in distant bioclimatic zones. **Photo: A. Gorski**

Shumard oak (Quercus shumardii), dramatic against the Space Needle. These trees grow in the triangle at Sixth Avenue and Denny Way. Photo: M. Black

Seattle's Green Triangles
Part I—The Trees

*MARVIN E. BLACK**

When the program titled "Operation Green Triangle" began in 1968, its goal was the transformation of the weedy triangular wastelands in Seattle street intersections. The city had many such undeveloped triangle spaces, and the Seattle Chamber of Commerce proposed planting them with tough, low-maintenance trees and groundcovers. In fifteen years, Operation Green Triangle has stimulated the renovation of more than 50 triangles, achieving much of the goal.

*Seattle City Arborist

There has been one excellent bonus. These plantings are fine areas for testing plant material in harsh urban situations surrounded by moving traffic; as field laboratoratories they have taught us a great deal.

Many worthy plants are uncommon in nurseries. Assembling 20 to 200 or more for a street planting may be virtually impossible. Thus, a landscape designer may be faced with a desirable material being in short supply. The simple decision may be made to plant only readily available materials, a decision which has much to commend it. However, such a course of action

leaves the marketplace as the nearly sole determiner of materials available to use, not an ideal arrangement, for we will get sameness, not diversity or even much advancement, by merely following the marketplace. To be fair, many men and women who run nurseries have ventured to try little-known materials, have realized only limited sales, and have turned in frustration to the tried-and-true. If we wish diversity, we must reward with our patronage those nurseries that are trying to furnish it. The triangles have the potential of serving both the City and the nurseries by offering the public a place to observe certain fairly rare or less-used plants in action, miniature arboreta sprinkled about the city.

The Trees

After the first fifteen years' testing, eight broadleaved trees emerge as candidates for wider use. Three are oaks. Perhaps the finest is *Quercus shumardii,* the Texas red oak or Shumard oak, a close relative of northern red oak *(Q. rubra).* This is the triangle tree at Sixth Avenue and Denny Way. It will ultimately grow tall, at least as tall as *Q. rubra*. However, it has a more majestic upright habit, is less wide-spreading, and its lighter red fall color gives a livelier effect than *Q. rubra's* mahogany red. The strongly upright tree tends to have a single leader in youth. The bright vivid green leaves are a bit smaller and more deeply cut than those of *Q. rubra,* very close to *Q. coccinea*. The finest feature of Shumard oak compared with other oaks is its ability to form a shapely head well before age ten, at least five years earlier than other red oaks which stay gawky and awkward to an embarrassing age.

Another oak that has performed well is the pin oak cultivar called 'Sovereign', botanically *Quercus palustris* 'Sovereign'. This tolerates poor soils and poor drainage like the species, and has deeply cut attractive sunset-colored leaves in autumn. Its superior feature for street use is its branching habit. Not typically downswept like most pin oak branching—which can sweep down onto lawns—this one has branches ascending somewhat from the horizontal, a great improvement where busses and moving vans are involved. Its current problem is that it must be grafted. No red oak is a major success as a grafted tree; all have shown a propensity to be incompatible, with the graft top

Foliage and acorns of holly oak. **Photo: M. Black**

(scion), breaking off from the understock after five or ten years, leaving a broken-off tree at ground level. 'Sovereign' has had some trouble in this respect elsewhere, but so far after ten years none of our Seattle trees has shown graft incompatibility. See this handsome tree at 23rd Avenue South and South Grand Street, and at Southwest Roxbury Street and Delridge Way Southwest.

Completing the trio of oaks with potential is the evergreen *Quercus ilex,* the holly oak. This tree is centered in the twin triangles at North 45th Street and North 46th Street where they are crossed by Midvale Place North, just east of

Holly oak, *Quercus ilex.* **Photo: M. Black**

Aurora Avenue North. Unlike the two above-listed oaks which are North American in origin, the holly oak is from southern Europe and Morocco. In Seattle *Quercus ilex* often seems homesick for its Mediterranean home, and wants careful placement in a warm location facing west or south. These triangle trees, facing to the south, made only minimal growth the first several seasons. Established now, they are compact balls with fast whiplike growth approaching two feet annually, reaffirming the promise that they can achieve 50 feet or more at maturity as they do in England. Our trees are prolific acorn producers; seedlings are growing beneath them. The leaves of holly oak are only two inches long and half that wide, leathery with sometimes willow-smooth margins and willow appearance but more often with small notches and serrations that suggest holly. *Quercus ilex* forms a pollution-tolerant street tree in Los Angeles, with leafy canopies meeting across the street. In the northwest, because young plants grow slowly and few nurseries attempt it (ours came from southern California), the price is five times that of other oaks, which tends to limit its use.

Liquidambar styraciflua has proven to be a satisfactory street tree in Seattle. Known as sweet gum, this is many people's favorite because of its tall picturesque shape, clean maple-like leaves and bright autumn red, gold and maroon color. In the triangle at Fauntleroy Way Southwest and Southwest Morgan Street, trees of the ordinary species are intermingled with those of a showy cultivar, *L. styraciflua* 'Gold Dust'. In this form from Oregon, the leaves are edged and streaked gold to ivory. In sunshine, this can give a bright halo effect around the tree. The fall color substitutes pinks for the normal reds in the leaves, like some leafy dessert. Cults have formed of devotees of variegated foliages; other cults have risen to oppose

Sweetgum *(Liquidambar)* on Stewart Street. Photo: M. Black

all such heretics. Many people who normally dislike variegated leaves have admired this particular tree.

Fraxinus ornus of all the ashes is the one that most often is called flowering ash. Its showy masses of frothy small ivory blooms early in the summer look as if some decorator had hung them among the fernlike green branches. It forms a smallish round-headed tree. At the triangle at Fauntleroy Way Southwest and Southwest Juneau Street and on North 34th Street bordering the North Seattle Transfer Station, the performance of flowering ash convinces us that it deserves wider use as a street tree. Perhaps this limited demonstration will spark a modest demand in the trade, where it is relatively rare.

Norway maple *(Acer platanoides)* is a mainstay street tree in Seattle and most cities. A tough tree tolerant of harsh conditions, it is sometimes faulted for rather weak fall color, tawny gold for the most part. In Seattle the species often picks up some peach color in fall leaf highlights, and in the cultivar *A. platanoides* 'Cavalier' these highlights gave the trees a strong orangey-red look this fall. The triangle group at Denny Way and Western Avenue was particularly showy. 'Cavalier' is more upright-compact than the species. This tailored, shapely tree merits wider distribution; it is relatively new.

'Cavalier' maple in the triangle at Denny and Western.
Photo: M. Black

Hawthorns *(Crataegus* spp.) are widely and appropriately attacked in print as brushy masses attractive only to aphids when not in bloom. Common flowering hawthorns are mostly variations on the English hawthorn, and have a week of glory in May with showy red, pink or white masses of blooms. Other hawthorns, more modest in flower, offer a much wider assortment of season-long charms. One is the very formal-appearing *Crataegus* x *lavallei,* the Carriere thorn, a hybrid of the Mexican *C. pubescens* forma *stipulacea* with *C. crus-galli,* having very large reddish orange fruit recalling its southern parent. This tree borders the two triangles on Midvale Place North mentioned earlier, with *Quercus ilex* in the center. In its youth the tree is densely globe-shaped as if it had been sheared. With age, the upper branches arch outward in more open, picturesque fashion. Foliage is large, oval and glossy deep green, unusual for a hawthorn, a handsome foil for the jewel-like fruits. These fruits, similar to little crabapples, last all winter; the leaves start out looking like they might be evergreen, then drop about Thanksgiving after turning almost the color of the fruit, producing a fascinating fall color effect.

Washington thorn, *Crataegus phaenopyrum,* another notable hawthorn, is in strong contrast to Carriere thorn. This has the smaller triangular leaves one expects in a hawthorn, toothed and lobed, strung in airy fashion along the branches. The tree has a more open look than the usually congested English hawthorn. Its branches have a definitely horizontal layered aspect compared with the upswept habit of the English haw. Washington thorn is a pretty winter tree, with fine patterns of thin-twigged branches fanned like etchings against the sky. Its clustered white flowers in June are a modest effort, but the leaves have a good green vitality, particularly in August, that English hawthorns lack. These leaves are prettily highlighted red and orange in autumn, both from some leaf color change and also from innumerable clustered rich red small berries, clusters the birds usually finish off by

Washington thorn *(Crataegus phaenopyrum)* and *Viburnum davidii* grace the triangle at Montlake and Louisa.
Photo: M. Black

HAWTHORNS IN GREEN TRIANGLES

Carriere thorn, *Crataegus* x *lavallei.*

Photo: M. Black

The glossy foliage and jewel-like fruits of Carriere thorn, *Crataegus* x *lavallei.*

New Year's. This tree is in fine form in a triangle near the Arboretum, on West Montlake Way East at East Louisa Street and 20th Avenue East. Our two star-performing hawthorns are relatively free of the aphids and disease problems that make most hawthorns unsightly late in summer. Neither would be a good choice in a very windy location, for they have small, non-greedy root systems.

Three conifers have done particularly well in triangles. Right in the heart of downtown Seattle, a giant sequoia *(Sequoiadendron giganteum)* dominates the Fourth Avenue and Olive Way intersection. This tree was moved in, already 15 feet tall, from a previous locality in a planting on Mercer Street. The sponsors of this downtown triangle contemplated the plant material only as a setting for proposed sculpture. Landscape architect Rosemary Wills studied the site, decided that no sculpture would be heroic enough surrounded by such large buildings, and sold the sponsors on the idea of a *Sequoiadendron* as green sculpture. The tree is thriving, has a good pollution tolerance record in other cities, and should survive a century or so. It has a very dark bluish-toned green color, and grows in a dense single spire like a classic holiday conifer. Indeed, electrical outlets were provided near the base should lighting ever be contemplated.

Washington's state tree is the western hemlock, *Tsuga heterophylla,* common in Puget Sound woodlands and some Seattle parks and greenbelts, and a useful tree in gardens. This abundance of the western hemlock has left the eastern hemlock, *Tsuga canadensis,* relatively absent in Washington gardens, though it is in most cases a superior garden tree because of its smaller size and more compact growth here. A hillside triangle in the University-Ravenna district, at Northeast 54th Street and Ravenna Avenue Northeast, has a flourishing colony of *Tsuga canadensis,* and shows well why it should be more often considered by gardeners and offered in nurseries.

Alaska yellowcedar (or just Alaska cedar), *Chamaecyparis nootkatensis,* is on its way to becoming a highly popular tree in Puget Sound gardens, and there are many good specimens in Seattle. This is the drooping-weeping evergreen with foliage hanging like green curtains. The exceedingly weeping forms are simply selections from the species that have more extreme vertical hang than the normal; the tree always weeps to a considerable extent. It will replace the overused Port Orford cedar or Lawson cypress *(Chamaecyparis lawsoniana)* because of this graceful habit, good durability under a variety of fairly bad conditions including poor drainage, and its resistance to the *Phytophthora* root rot that is killing the Port Orfords. There are some nice 15-year-olds in the two triangular points at the intersection of 35th Avenue Northeast and Northeast 135th Street.

(to be continued: the shrubs and ground covers in the triangles)

Giant sequoia at Fouth Avenue and Olive Way.
Photo: M. Black

The Arboretum Nursery as viewed from Arboretum Drive, December 1983. Photo: C. Antieau

Digital Daphne Arrives!
A New Inventory Management System for the Arboretum Nursery

*CLAYTON J. ANTIEAU AND JAMES R. CLARK**

Editor's Note: Joseph Witt was delighted when, in 1982, a new system for listing the plants in the nursery areas was made available to him through the authors' combined efforts. At long last there would be no more time-consuming proofreading and typing, no more obsolete listings. This computer-assisted inventory system is proving to be decidedly more practical and time effective than the previous manual method, and enhances plant management and collections management at the Washington Park Arboretum.

Essential to the maintenance and improvement of the Washington Park Arboretum's collection of woody plants is the nursery. In addition to being a trial area for the many genera, species and varieties introduced to the Arboretum, the nursery is also a resource to be used in the replacement of existing specimens, in the expansion of specific collections and in the creation of new displays. Furthermore, the nursery is especially valuable to the collections because it is the permanent location of several important specimens, plants which have now grown too large to be moved. Two of these, a thirty-year-old *Acer macrophyllum* 'Seattle Sentinel' and an original seedling that is now known as *Mahonia* x 'Arthur Menzies', are significant in that both are Arboretum introductions.

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Because of its importance to the long-term quality of the plant collections, the nursery is a busy and intensively managed section of the Arboretum. More than 2000 plants are located there and much labor is spent cultivating this stock and in moving plants to and from the sixty-one nursery rows. For the sake of recordkeeping and locating plants, these rows are divided into a total of six divisions.

Prior to 1982, a nursery inventory was taken once each year. An employee of the Arboretum, or a student, would visit the nursery after the spring planting season and—with the previous year's inventory in hand—would rewrite the entire inventory, noting for each plant its accession number, location in a division, the botanical name, the number of plants (if one or more plants of that number were adjacent) and sizes. The completed inventory would then be hand-typed into a final and formal copy.

A major disadvantage of this former method was the amount of time needed to recreate and type the revised inventory for a given year. These typing and transcribing processes made the inventory prone to numerical and spelling errors each year. Due to the restrictions of space and time, the number of details included on the inventory was limited, periodic revisions were impractical and alphabetization was impossible.

During 1982 a new approach to the nursery inventory was explored in hopes of increasing the speed, detail, accuracy and retrievability of the inventory. This approach involved the use of a computer-based information management system available at the University of Washington's Academic Computing Center. The system is called UWRIM, the University of Washington Relational Information Management System. Clark and Cummings (1983) have presented an introduction to the mechanics and uses of this database management system.

A database management system is a computer program that deals with the structure, organization and manipulation of information, rather than with data analyses and calculations (Clark and Cummings, 1983). The inventory project uses the UWRIM program as well as a lengthy computer file which holds the "raw" information taken from the nursery.

Each line or row in this computer file represents a single plant positioned in a row of a nursery division. Within this file there are eleven columns of information describing the location, accession number, genus, species, variety, family and size of the plant. A final column is left open for comments. An actual entry might look like the example in Table 1.

During August, 1982, a physical inventory was taken as usual, but instead of being typed into formal copy, the resulting information was entered into the computer file. These data were then loaded into a program created by the

***Acer macrophyllum* 'Seattle Sentinel', the upright form of bigleaf maple.** **Photo: E. F. Marten**

***Mahonia* x 'Arthur Menzies' in the Arboretum nursery.** **Photo: C. Antieau**

UWRIM system, enabling the operator to obtain a listing—alphabetized by species and then variety—of all the plants in the nursery. By using a subprogram called Report Writer, the operator was able to organize the listing and to selectively print columns. This was the first time in the history of the Arboretum that an alphabetized nursery inventory was available.

The computer file and resulting listing allowed convenient updating of the inventory during the following year. The Curator of Plant Collections simply crossed off the plants which had been planted out of the nursery and noted the planting dates directly on the listing. This provided concrete pieces of information about the histories of individual plants, as well as a clear statement of which plants remained in the nursery.

Similarly, the nursery manager kept lists of plants moved within the nursery, of plants dead and removed from the nursery, of plants set into the nursery, and of those planted out. These lists enabled the computer operator to make the necessary corrections in the computer file without having to visit the nursery. As a result, updated listings could be obtained at any time of the year.

A quick trip through the nursery was required in October 1983 to check the accuracy of the new method, to make additional comments and to note changes in the plants' sizes. A current alphabetical listing has since been produced for 1983 and 1984. Additionally, an alphabetical listing of all *Acer* in the nursery has been prepared for use in an Arboretum-wide relabeling and cross-checking of the Japanese maple collection. Lists based upon location and lists indexed by family are also available.

More advantages of the computer-assisted method include periodically revised printouts, selective retrieval of any combination of information, and indexing capabilities. All output is double-spaced in easy-to-read print on large computer paper with plenty of space for written notes and comment. Another benefit of the new method is that by using a television-like display terminal an operator can select, tally, index, sort and/or locate information from the computer file without ever requiring a single piece of paper for the process. Computer files, unlike paper, are also safe from loss by fire or misplacement.

Furthermore, the computer file and program are able to conveniently accommodate and maintain more than twice the amount of information than the former method was able to handle. Having available data such as current taxonomic and varietal information, source of acquisition (when necessary), and detailed information on size and condition of plants means that the inventory can become an even more important tool in the day-to-day activities of the Arboretum staff and in tracing the performance and history of a plant acquisition.

REFERENCES

Clark, James R. and Daniel Cummings. 1983. UWRIM: A database management system for horticulturists. *Hortscience* 18(2):151-154.

Table 1. A Sample Entry from the Nursery Inventory Computer File

935 N 4 1 "495-67" ACER LAXIFLORUM -0- ACERACEAE +
"12FT—1.5DBH" "EX WESTONBIRT"

COLUMN	DATUM	EXPLANATION
NUM	935	Identifer. A unique numeral for each line in the file aids in file editing and in distinctly identifying multiple plants of a single accession.
LOC	N	Location. A location code states that the plant is in the nursery (N). Expansion of the inventory will lead to codes for lathhouse (L), greenhouse (G) and coldframes (C).
DIV	4	Division. This plant is located in this division within the nursery.
ROW	1	Row. This is the row number within the specified division.
ACCNO	495-67	Accession number. The 495th accession received in 1967 is assigned the accession number 495-67. Paired quotation marks are necessary signals informing the computer that the enclosed string of characters is alpha-numeric.
GENUS	*Acer*	Generic name.
SPECIES	*laxiflorum*	Specific epithet.
VARIETY	-0-	Cultivar or subtaxon. In this case there is no cultivar or subtaxon so the characters, -0-, are entered as a signal to the computer that no information exists for this column in this line.
FAMILY	Aceraceae	Botanical family. In this example, this datum is followed by a + which informs the computer that the entry is continued on the line below.
SIZE	12FT—1.5DBH	Height in feet, width in feet, diameter at breast height in inches. This plant is approximately 12 feet tall with a 1.5 inch trunk at breast height.
COMMENT	Ex Westonbirt	Comment. This acquisition was obtained from the Westonbirt Arboretum of the British Isles.

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Events of Interest

ARBORETUM LECTURE SERIES: held Wednesday mornings at 10. Call the Arboretum for further information (543-8800). On March 14, Dr. H.B. Tukey, Jr., Director of the Arboretum and Chairman of the Center for Urban Horticulture, will speak on FOLIAR NUTRITION, THE CONTRIBUTION LEAVES MAKE TO WHOLE PLANT NUTRITION, presenting a foretaste of the kinds of research we can expect from the Center that will benefit our knowledge of plants and gardening.

FOURTH THURSDAY WEEDERS' DAYS resume in the New Year. See you on February 23 and March 22. Meet at the Arboretum Office at 10 AM.

NOHS LECTURE SERIES: held in the McCurdy Room of the Museum of History and Industry, 10:30 AM. On February 29, Dr. Molly Sanderson will speak on A GARDEN IN NORTHERN IRELAND. This captivating speaker, whose vocation is general medicine but whose avocation is gardening, has one of the most notable gardens in northern Ireland. She specializes in primulas, and will deal in her lecture with herbaceous material mixed with a variety of challenging and rare shrubs. On May 22, Dr. Peter Valder will present THE EXTRAORDINARY FLORA OF AUSTRALIA. Senior lecturer in the Department of Botany at the University of Sydney, Dr. Valder is author and narrator of "The Curious and Diverse Flora," a film first shown at the 1981 International Botanical Congress in Sydney. Tropical rhododendrons *(Vireya)* will be featured by this entertaining speaker.

FLOWER ARRANGEMENT AND DEMONSTRATION by internationally renowned Sheila Macqueen, arranger and author from London, sponsored by the Seattle Garden Club. March 1, 1984, 10 AM, at the Museum of History and Industry. $15 per ticket. For more information, please call Judy Addington, 454-4737.

Director Harold B. Tukey, Jr., welcomes guests to the Center for Urban Horticulture groundbreaking ceremony. The amaryllis in front of the microphone were brought from the Arboretum greenhouse. Photo: Joe Freeman
University of Washington Photographic Service

Concrete Accomplishments—
Breaking Ground at Union Bay

*JOYCE BREWSTER**

More than 100 friends of the Center for Urban Horticulture gathered in brilliant sunshine last August 18 to celebrate the breaking of ground for the Center's new headquarters building at Union Bay. Plant and garden societies, commercial and professional organizations, University of Washington officials, major donors, and Center faculty, staff, and students were all represented.

From the shade of a festive white canopy, guests looked out across the grassy field that will become the Center's new home and heard warm thanks for their support from Center Director Harold B. Tukey, Jr., University President William P. Gerberding, and Provost George M. Beckmann. Dr. Tukey then called on a graduate student of the Center to bear the ceremonial shovel—"the mace for this occasion"—and the crowd trooped out a few yards to the actual building site. President Gerberding lifted the first shovelful of earth; major donors and other dignitaries took subsequent turns; and finally the shovel was offered to all comers and the dirt flew amid cheers and laughter. The morning concluded with a champagne reception under the canopy.

*Development coordinator for the Center for Urban Horticulture.

This first building of the Union Bay complex is scheduled for completion by late spring of 1984 and will add important facilities to the nearby Arboretum. A horticultural library will house the books and journals that have been donated over the years, many of them now inaccessible. A full-fledged herbarium will provide space for preparation, storage and use of the dried specimens that constitute the "library" of the plant collections. Equipment for computerizing the Arboretum's plant records will keep these essential data completely current and easily available for a wide range of queries from staff or public. A large workroom will be devoted to preparing exibits, displays, and material for continuing education classes. The building will also include laboratories, classrooms, small meeting rooms and offices. Together wilh the new Arboretum Visitor Center, which should be ready by fall 1984, the Union Bay building will give the Arboretum another dimension of usefulness and pleasure for both public and staff.

Like most such occasions, the groundbreaking ceremony represented the fruition of years of dreaming, planning and campaigning. Virtually everyone present had a personal stake in the project's development, and many were veterans of long standing. It had all begun with a question: how could the resources of the Arboretum and the University, the blessings of the Northwest climate, and the support of the region's strong horticultural community be forged into a new horticultural program of the first rank? The answer that had evolved was the Center for Urban Horticulture: a program of research, teaching, and public service, based at the University but with strong ties to community and professional constituencies, sited at Union Bay but indivisible from the Arboretum, and focused on growing plants in cities. When the Center was officially established in 1980, it was the first such institution in the country. If the high spirits pervading the ceremony are any indication, it is an idea that has found its perfect place and time.

As funds are assembled, the next phases of the Union Bay project will proceed. First in line is the construction of a multipurpose Conference Hall, adaptable for large or small gatherings,

Pendleton Miller tosses out a shovelful of earth as President Gerberding, Dr. Tukey, and Provost Beckmann look on. Mr. Miller's major gift will establish the Elisabeth C. Miller Horticultural Library in the new building in honor of his wife Betty.
Photo: J. Freeman

Prentice Bloedel With Col. and Mrs. Leroy Collins. Col. Collins is President of the Arboretum Foundation; Mrs. Collins is an Arboretum Office Volunteer.

At the champagne reception after the ceremony, members of Puget Sound's extended horticultural family exchange news, reflections, and good cheer. Photos: Joe Freeman
University of Washington Photographic Service

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Jean Witt, iris specialist, are i

Mr. and Mrs. Prentice Bloedel, center, listen to President Gerberding's account of their many horticultural projects. Major contributors to this building, the Bloedels have also given to the University their beautifully landscaped estate on Bainbridge Island, the Bloedel Reserve. On the left is Mrs. Bloedel's sister, Mrs. Corydon Wagner; they are daughters of R.D. Merrill, the pioneer lumberman whose bequest provided the nucleus of the Center building fund. University Regent Mary Gates is on the right.

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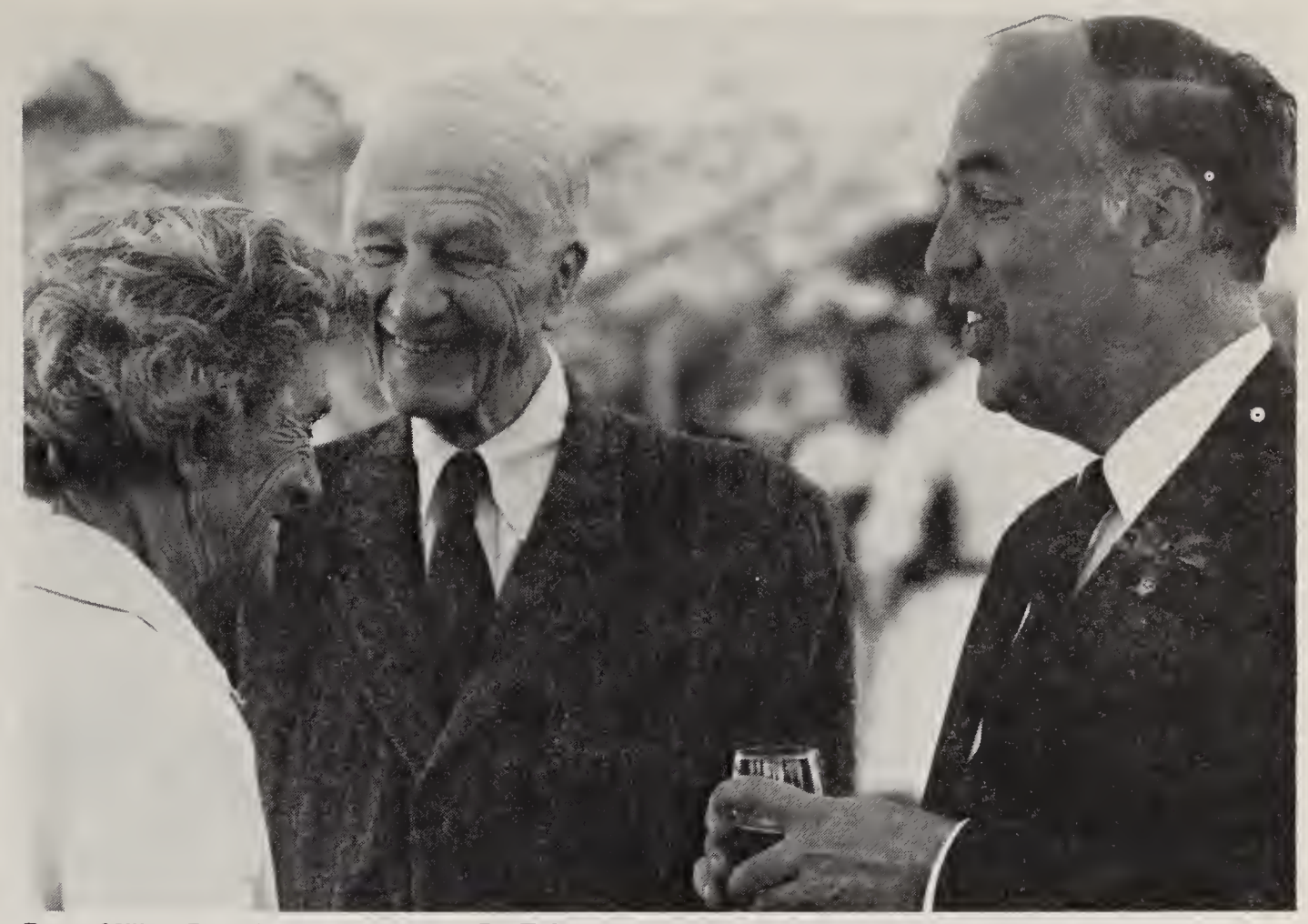

Betty Miller, Prentice Bloedel, and Dr. Tukey.

Mrs. Corydon Wagner, Brian O. Mulligan, Director Emeritus of the Arboretum, and Professor William H. Hatheway of the Center faculty.

where the region's many private horticultural groups can schedule meetings, lectures, workshops, plant sales and other events. The Center will also base its own public service activities, including continuing education courses, in the Hall. A small building with office and storage space for private support groups will be next. The headquarters building, Conference Hall and support building will be clustered around a central, weather-protected courtyard. A nearby greenhouse/headhouse complex will serve both the propagating needs of the Arboretum and the research and teaching needs of the Center. Finally, a variety of plantings and gardens will stretch out from the buildings toward the grasslands that border Union Bay. Designs for the whole complex by architects Jones and Jones won a 1982 Award of Merit from the American Society of Landscape Architects.

Just a few weeks before the Union Bay groundbreaking, Dr. Tukey had delivered the opening address of the First International Symposium on Urban Horticulture in New York. "As the world population grows," he had told the assembly, "and people are increasingly crowded into dense clusters, the need for understanding the growth of plants within cities and the effects of these plants on human beings becomes critical." This is the mission of the Center for Urban Horticulture. The first step was really taken fifty years ago, when earlier visionaries began making a magnificent arboretum near the heart of downtown Seattle. With the ceremony last August 18, horticulture in the Northwest passed another milestone.

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Sawdust Straight from the Saw

GEORGE SCHENK

Raw sawdust has proven to be a great weed deterrent, labor saver, and plant encourager in all my garden beds. With no thought to the nitrogen-grabbing propensity of unrotted sawdust, widely warned-of in garden literature, we spread sawdust *sans* fertilizer as deeply as garden plants will take it without being smothered. While flat-growing shrublets and vines *(Vinca, Euonymus, Gaultheria, Epigaea* and others) can't tolerate a sawdust cover, taller shrubs and dormant perennials can, and will benefit. We spread sawdust approximately three inches deep over the roots and buds of wintering woodland flowers such as bleedinghearts and trilliums, six inches deep about the crowns of large ferns and the trunks of trees and shrubs. Plants come up through the topping unhindered, but few seedling weeds appear.

The commonest sawdust in this region comes from the milling of Douglas fir. And it's the best, although of a frightening blond color—one would never associate garden goodness with this most unearthy medium. Yet, plants seem to love it, and will root in the pure stuff. Experimentally, I've set out new plants of woodland flowers and ferns in mill-fresh sawdust above composty soil, counting on the roots of the plants to find their way down. The several dozen kinds of woodland plants (hostas, geraniums, epimediums, violets and others) I've tried have all taken hold faster with this use of sawdust. *Linnaea borealis* and *Cornus canadensis*—two woodland ground covers slow to establish in the best woodland compost—go ahead quickly in sawdust over soil.

Sawdust is also a labor-saver in setting out plants. In seconds the planter scoops a planting pocket in the fluffy medium, then draws the sawdust blanket closely about roots and stems—goes faster than planting in denser, heavier soil.

Arboretum Director's Report

Together We Stand . . .

H.B. TUKEY, JR.

Almost four years ago we agreed together on a plan to improve the horticultural program in Seattle in general and in the Arboretum specifically. Our plan was to build a strong program in academic horticulture, which we have called Urban Horticulture, to attract the faculty and students who would use and enhance the Arboretum and to provide facilities and support services for the Arboretum. The budget history of the Arboretum, particularly in the preceding decade, was strong witness for the need for a change in policy. The Arboretum Foundation, along with other groups, agreed to support this program and I came to Seattle with great enthusiasm to direct it.

Today, we stand on much stronger ground. Together we have assembled a strong and internationally prominent faculty. We have eight graduate students, three of whom are using the Arboretum for their research. The carefully planned funding program developed over the past years, with the help of the Development Office and of skilled fundraising personnel has begun to bear fruit. More than $1.5 million has been donated for our horticultural programs, including the Arboretum. The headquarters building with important facilities to support the Arboretum, will be open in March. The regional horticultural library has been established with a gift of $500,000, providing for construction, furnishings, and the endowment of a librarian position for continued growth. A major gift has established the Herbarium for Horticultural Plants, which will be based on the plant collections in the Arboretum.

With the completion of the headquarters building, I have invited the Arboretum Foundation, through President Collins, to have its office there temporarily during the construction of the Visitor Center. An office and meeting rooms for the Board of Directors are available and you, the members of the Arboretum Foundation, should be among the first to share in the new program which you have helped to support.

We now have a building program for five separate facilities, when three years ago we had none. The horticultural headquarters will be followed by the Visitor Center in the Arboretum and in turn will be followed by a Conference Hall that will provide space for meetings, lectures, and plant exhibitions for all horticulturists. Next, we expect to renovate the Arboretum greenhouse, complete the new research greenhouses and growth chamber facilities, and build a horticultural support building where organizations who support our program can have offices.

New activities have been initiated and strengthened. In the fall, we held the first Horticultural Forum, at which representatives from all the horticultural organizations in the Puget Sound area discussed mutual needs and aims. Coming from that meeting is a proposal that with volunteer help, we could provide computer facilities for maintenance of mailing lists, horticultural calendars, and a speakers' calendar. Many organizations have similar problems with mailings and membership lists, and with a small effort, we can benefit a large number of organizations at very little cost. The Arboretum courses have been revived, up to fifteen per quarter for a total attendance of 1,000 people per year. The Pink Sheet is widely distributed as are newsletters and notices of seminars for the commercial plant maintenance industry. New positions have been created, those of Arboretum Naturalist and of Coordinator of Continuing Education. The Arboretum office is staffed by volunteers and they do a great job. All of this has been accomplished in a short time with the moral and financial support of the Arboretum Foundation and its Unit Council. And not one penny of donated money from the Arboretum Foundation has been spent outside the Arboretum itself.

Every cloud has its silver lining. The sad cloud of Professor Witt's illness has had the silver lining of staff growth and development. We now have the personnel and the enthusiasm to

respond to such an emergency, and our staff have responded splendidly. Mrs. Pirzio-Biroli has taken on the plant leadership in the Arboretum, and with the help of Mr. Mulligan and other volunteers has continued our training sessions and meetings, and work with the Index Seminum and the plant collections. Mr. Bobbitt has come into the Arboretum to coordinate the ever more effective volunteer program and to oversee the Arboretum office in addition to his regular work with extension and commercial audiences. All of us are indebted to Mr. Hart, to his excellent staff, and especially to Mr. Hoyt in grounds and Mr. Powell in the greenhouses for the day-to-day leadership for maintenance of the plant collections.

All in all, the plan envisioned four years ago for saving and enhancing the Arboretum is working splendidly.

But there is much more to be done. I asked Professor Witt to prepare a master plan for renovation of the plant collections and support services of the Arboretum. He delivered a rough draft of this plan before he was taken ill and in October I shared his thoughts with President Collins. The report called attention to the sad condition of the primary resource of the Arboretum, the plant collections. After all, it is the plant collections that make it an Arboretum. The master plan calls for immediate improvement of six areas:

- reconstruction of Azalea Way;
- renovation of the greenhouses;
- renovation of the plant collections along Azalea Way to improve visual and horticultural interest;
- reestablishment of the important plant introduction program;
- pruning and removal of overgrown weed trees and renovation of several of the collections, especially *Rhododendron, Sorbus, Acer, Quercus, Tilia* and *Ilex*.

The estimated cost of these renovations is far in excess of $500,000.

During my visit in October with President Collins, I asked him to consider the need for developing a comprehensive Arboretum-wide funding campaign to cover the costs. At the same time, I invited the participation of the Arboretum Foundation in review of the plan and in the campaign.

Such a program requires careful coordination. There are presently seven major funding campaigns in planning or in progress for horticultural interests in Seattle. The retreat of the Federal government from support of some such activities has put additional pressure on foundations and individuals who can help. Campaigns must be carefully planned and thoroughly justified, carefully coordinated with all parties, and even more carefully supervised. No longer can each special interest group go out on its own. This is especially true in the Washington Park Arboretum where so many interests, loyalties, and dreams must be coordinated to achieve the goals we have agreed upon.

We have turned a corner in horticulture in Seattle and particularly in the Arboretum. We are already into the exciting future, a future which requires a closely coordinated approach to planning and funding. It is a future which requires strong leaderhsip from the Director's office, leadership which I am prepared and anxious to give. It requires *support* from individuals and organizations among which the Arboretum Foundation, the primary support group in the Arboretum, has a prominent role. We must work together for TOGETHER WE STAND . . .

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THE TIGER'S EAR: TEXTILE ARTS OF THE HMONG AND MIEN is featured in the entry gallery of the Burke Museum.

Requiem for a Haybaler: Throwing in (out) the Trowel

*KARL URBAN**

My recent decision not to renew my membership in the Native Plant Society of Oregon has generated some insignificant concern which may or may not be misdirected. I like to think of the decision "to throw out the trowel" as a pivotal point in my life . . . one that will allow me with clear conscience to appreciate fully the overwhelming natural beauty of my adopted state, Oregon.

As a professional whose love for field studies is immeasurable, I can reflect upon the significant events that led to the development of my present philosophical (non-collecting) perspectives. Those events, I now realize, were ominous.

First there was the college class that made me realize that there was more than sagebrush in southern Idaho. I submitted a collection of seventy-five plants to qualify for an "A" in that otherwise rigorous course. The lesson "to press" was lasting and fun. By the end of that summer (1962) my accession (press) book number was above 500 and the stack of newspapers in the corner of my bedroom reached almost the level of my bookshelves.

My stint with the National Park Service legalized my haybaling activities. With permit, press and trowel in hand I traversed the lava flows. "Collect two—one for me and one for you!" was my motto. Several years later the stack of newspapers had reached the ceiling. My accession book bulged with its 4000+ entries. And then came Oregon!

The letter from my parents in 1969 announcing the conversion of my old bedroom to a sewing room was most unsettling. That "old stack of newspapers in the corner" had been burned.

It was also in 1969 that the Wallowa Mountains delivered a convincing message. Laden with backpack, Peck and press I clumsily attempted an early spring crossing of the swollen West Fork of the Wallowa River via footlog (the bridge to Ice Lake had washed out). I barely survived the dunking. My pack, press, Peck and accessions book must surely have entered Wallowa Lake by now! Little did I realize that my metamorphosis from hay baler to photographer and flower "sniffer" had begun.

Pyrola elliptica. **Drawing by Jeanne R. Janish, from Hitchcock, C.L. *et al., Vascular Plants of the Pacific Northwest, Part 4,* 1959. Courtesy of the University of Washington Press, Seattle**

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By the 1970's I extended my energies beyond the college day to share my love of northeastern Oregon's wildflowers with the seemingly-eternal residents of Umatilla County. How I loved those wonderful people who wanted to appreciate the natural heritage in which they had unknowingly been immersed for their entire lives! I started a new accessions book—the first number was 5000—compensation for my Wallowa ordeal!

How vividly I remember the summer of 1974. I had been introduced previously to Steens Mountain through an ecology class and was about to launch a taxonomy class of my own. I had it all mapped out. Each of my twelve students would earn grade "eligibility" by collecting and submitting to me fifty, seventy-five or a hundred pressed specimens during the three weeks of the course. I eagerly shared my course plans with my students during our initial meeting on that warm July night. I was met with outright hostility. Three students from Oregon State—Bill Baker, Steve (Reid) Schuller and Berta Youtie—voiced immediate disapproval of my collection requirements. They were in the class to become proficient in the use of keys and not to bale hay!

Deflated and dejected I analyzed the situation during a sleepless night. After all, the objective of the course was not to build the instructor's private collection. And so, after the electrically-charged debut the next morning I sheepishly announced that collections would not be required. If collections were made they were to go to the student's institution.

The fragile beauty of Steens Mountain immediately started to take its toll. By 1976 no collecting was allowed in my class on Steens Mountain. Like ornithologists who decades earlier learned not to destroy the creatures they study, my students hovered around living plants in their native habitats. One plant or one inflorescence sufficed for the entire class. I still cringe with guilt when I think of extricating *Allium campanulatum* from its alluvial rill in order to determine its subterranean characteristics!

Meanwhile in Pendleton the popularity of my wildflower identification class soared. Each Monday night the janitor carted out three garbage cans full of native plants brought in by my wildflower enthusiasts for "show and tell." It became a numbers game and it was never successful until our class number exceeded three hundred species during an eight week period. My professional conscience grew heavier. I began to realize that in my desire to share the floristic loveliness of my adopted state with others I had precipitated a "love-to-death" movement.

I began to plead with my older students. "Please don't pick flowers (or dig them) on the field trips I'm conducting or I'll quit conducting field trips," I said. The words fell on deaf ears. The bouquets of calypso orchids continued to wither in the sun. The trowels, plastic bags and presses still popped out of the car trunks after I had completed the wildflower walks. My teaching load grew heavier and wildflower identification disappeared from the college schedule. The night janitor no longer had to worry about the garbage cans of wildflowers. I had simplified his job—and mine too.

Then came my stint with the Native Plant Society of Oregon. I remember the glorious state meeting we hosted at the Malheur Field Station and I also remember well the faces behind the presses and plastic bags on our outing around Steens Mountain. I also remember the splendid Fourth of July '81 outing our Blue Mountain group sponsored on Steens Mountain. I reservedly showed participants some real treasures—plants that had taken me years to find. By July 5th only gaping holes surrounded by footprints marked the sites where the day before there had been *Allium campanulatum, Lewisia rediviva, Dicentra uniflora* and *Claytonia nevadensis*.

But I also remember the Fourth of July outing we sponsored in 1982 in the Wallowas. That botanical "high" will last me forever because all of the rare plants we saw were left for posterity. Everyone who participated in that trip seemed to respect the Society's creed.

My decision to leave the ranks of NPSO is difficult in many ways and easy in others. I realize no one else on earth would share my exact philosophical concerns about our native plant heritage. I do not ask that. However, I tire of collecting rationales which echo ominously with each confrontation:

1) "I have to get a specimen of the plant to share with others who couldn't get out on the field trip. Sorry to have taken three of the four we saw!"

2) "I have for an entire lifetime gone to the woods to pick bouquets of wildflowers. I'm not changing now!"
3) "This land is managed by the Forest Service so I'm going to dig all the rare or pretty plants and transplant them to my garden. I just know the Forest Service is going to log the area or build a road right here so I'm going to save these wildflowers!"
4) "God put them there for *me* to have."
5) "Keys are written from pressed plant specimens. Indeed the whole science of taxonomy is based upon pressed specimens. I'm advancing the cause of science!"

As my students at Blue Mountain Community College learn plant families and Hitchcock by keying *weeds* that I've collected for them, those echoes linger. But yearly the same behavior is enacted and this reminds me of Aldo Leopold's prophetic words: "The stampede is an attribute of animals interested solely in grass."

To the bearers of trowels, plastic bags and presses I can only express my deepest sympathy. Surely such individuals share in their hearts the same elation at "having" that the Mr. Smith or Jones who shot the last passenger pigeon from American skies experienced long ago.

A flower is an exquisite thing—beautiful, delicate and a harbinger of hope for the green world that lets us all survive. I find no need to claim that flower as my own. With clear conscience I throw out the trowel! Flowers forever.

Orchard grass, *Dactylis glomerata*. Drawing: John Bolivar

Bellis perennis, sunflower family (Compositae)

English daisy is a small, fibrous-rooted perennial with elliptic to obovate leaves which lie flat and very close to the ground allowing it to flourish in lawns where it escapes mowing. The generic name may be derived from the Latin *bellus* (pretty), but its name may also stem from the name of the dryad Belidis. The common name is a corruption of the old English "day's eye." It is the "bairnwort" in Scotland, alluding to the joy of children in collecting it for daisy chains. It abounds in spring and early summer:

"When you can put your foot on seven daisies,
summer is come."

JOHN BOLIVAR

Why Leaves Change Color in the Autumn

*RICHARD B. WALKER**

We have all seen normally green leaves turn to a yellow, golden, or reddish shade during the autumn season. Possibly many have wondered just what happens in leaves to make possible this often spectacular change. Even more, one is likely to wonder how climate, weather, the nature of the plant species involved, exposure to sunlight, or other factors, make for variations in the nature and intensity of the color changes. Although all aspects of these processes are still not fully understood even by specialists in plant physiology, the general nature of the changes will be described in the sections which follow.

Leaf Pigments

The color of most leaves is some shade of green, although some are variegated and some may be red. All leaves, even the red ones, contain two principal colors or classes of pigments.

The first of these classes is the chlorophylls, well known for their green color. Most plants contain two separate but very similar chlorophyll pigments. The chlorophyll is situated in the chloroplasts, which are microscopic bodies that are part of the protoplasm of the leaf cells. The chlorophyll plays an essential role in the process of photosynthesis, in which carbon dioxide and water are combined into carbohydrate food using energy from light.

The second class of pigments is the carotenoids, which are yellow or orange, but whose color is ordinarily masked by the green color of the chlorophyll which is also present. There are two types of carotenoids, the carotenes that are usually orange in color, and the xanthophylls that are yellow. The carotenoid pigments are contained in the chloroplasts along with the chlorophyll, or may be present alone in similar but yellow plastids, which are called chromoplasts.

Those leaves which are partly or wholly pink or red (e.g., red-leaved *Prunus*, maples, and beeches), contain red pigments which mask the green and yellow ones which are also present. These red pigments are very different from the other types, as they are soluble in water and are dissolved in the central water droplet (vacuole) of cells rather than being in plastids. Although leaves of some species and varieties contain red pigment throughout the growing season, most leaves contain little or no red color during the spring and summer. Many of these may develop red color during the autumn, however, and this is considered in a section which follows.

Development of Yellow and Golden Colors

For a leaf to stay green, chlorophyll must be constantly synthesized, for it is always being destroyed at a certain rate even in active leaves. As late summer or autumn comes, the metabolism of leaves becomes less active, and among other things, the rate of chlorophyll formation slows down. At the same time the rate of chlorophyll breakdown increases, for reasons not well understood. The net effect of these changes is the loss of the chlorophyll of the leaf.

However, when the chlorophyll is gone, the leaf is not colorless. The yellow pigments are more stable than the chlorophyll, and remain intact as the chlorophyll disappears. Thus we see that many leaves have a yellow color as soon as the chlorophyll disappears. The shade of color depends on several factors. If carotenes predominate, the leaves may be orange, or if xanthophylls predominate, a clear yellow color may result. The presence of tannins in the leaf may modify the shade also, being especially important in the development of golden tones.

The leaves stay alive during the change from green to yellow, even though they are senescent, and often remain alive until they are shed in the late autumn. Death of leaves still attached to the tree is indicated by their turning brown. Heavy frosts may ruin the yellow colors by killing the leaves prematurely.

* Department of Botany, University of Washington.
This article is reprinted from the *UW Arboretum Bulletin* 24(3): 79-80, 94; Fall, 1961.

Development of Red Colors

The water-soluble anthocyanin pigments mentioned earlier are the ones involved in the development of red shades. Although all species which develop red leaves in autumn probably have some of the red pigment in the leaves earlier in the year, the amount greatly increases in the autumn if conditions are favorable. In such leaves the red colors develop about the same time that the chlorophyll is disappearing, so a clear red unaffected by green is seen. Usually the yellow pigments are still present, but they are masked by the red ones.

One of the most interesting aspects of the formation of red colors is the influence of weather and other factors on the development of anthocyanin colors. Experiments along this line have been difficult to perform because of the short time involved in pigment synthesis. Experiments and observations indicate the following, although some differences of opinion exist in some instances.

1. *Genetics of the plant*

Hereditary factors are important in the production of anthocyanin pigments. Some plants have a natural tendency to form abundant pigment, and these are more likely to be an attractive red color in the autumn. For example, the red maple forms abundant anthocyanins in the young twigs and developing leaves, and turns a brilliant red in the autumn. On the other hand the sugar maple shows very little red color in the young leaves, and in the autumn has much less in the leaves.

2. *Sugar level in the leaf*

In the autumn several factors combine to cause the production of high sugar contents in the leaves. Light intensity is still favorable for photosynthesis (of which sugar is an early product), the lower temperatures reduce movement of sugar to other parts of the plant and reduce use of sugar in cellular oxidation, and often corky abscission layers develop at the bases of leaves which restrict movement of food material out of the leaves. The red pigments are readily formed from sugar in the enzymatic reactions of the leaf cells, and there is a tendency for the anthocyanin to develop from the "excess" sugar in the leaves.

3. *Temperature*

The effect of temperature is probably related to the level of sugar described in the previous paragraph. That is, cooler temperatures favor higher sugar contents of the leaves and greater development of the pigments. Hard frosts, however, may damage the leaves and cause a reduction in the amount of color produced.

4. *Light*

High light intensities favor the formation of anthocyanin pigments, so clear, bright weather is necessary for the development of the best autumn coloration.

5. *Mineral nutrition*

Excessive amounts of nitrogen in the soil may reduce the amount of pigment development in leaves, as the sugars which would otherwise go into pigment formation may be combined with nitrogen to form proteins.

Deficiencies of nitrogen, phosphorus, and magnesium often cause the development of reddish anthocyanin pigmentation. Plants which show premature coloration, especially in the lower leaves, may be suffering from one of these deficiencies. On the other hand, adequate potassium should favor development of color, because of its stimulating effect of sugar formation, but no data on this point are available. The acidity of the soil probably has no effect on coloration.

6. *Water supply*

Some confusion and difference of opinion exists with respect to the effects of water. On the one hand, drought may cause premature coloration of foliage, but may also cause premature death and dropping of the leaves. Thus it appears that bright, clear weather coupled with a reasonable amount of rainfall which will keep plants and leaves in good condition produces the most favorable autumn coloration. Deficiency of water probably exercises its effect in increasing coloration because of the tendency for insoluble carbohydrates to be converted into sugars under drought conditions.

7. *Disease*

Diseased trees or isolated branches of trees often develop premature and strong leaf coloration. This is probably associated either with interruption of the movement of sugars from the foliage to other parts of the plant, or with a reduction in mineral or water absorption caused by damage to the root system or the conducting system.

Probably the senescent leaves which have developed yellow, orange, or reddish colors no

longer serve a useful function to the plant, but neither do they harm the plant nor use up very much of its food reserves. The leftover and by-product pigments of leaves play a prominent role, however, in our enjoyment of many plants during the autumn.

REFERENCES

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* * *

Asiatic Poppies

An old man who sowed *Meconopsis*
Was asked to give a synopsis.
  He said, "Though I tried
  Every one of them died—
I can only recite their autopsies."

as remembered by Ward Horn
from The Gardeners Chronicle *(of Britain)*

***Meconopsis* x *sheldonii* at Castlewellan, County Down, Northern Ireland. Photo: H.M. Mulligan**

The lovely blue Asiatic poppy can be grown in the flower or rock garden under cool temperate conditions, but most species require special attention, inspiring this lament in limerick form. *Meconopsis* is best grown from seeds, since it should not be disturbed after becoming established. These poppies need a soil sufficiently well-drained to be dry during winter but moist during the growing season. They should be planted in a somewhat shaded situation where they are protected from excessive summer heat and strong winds. Brian Mulligan notes that a spot good for primroses will be good for *Meconopsis*. Unfortunately, slugs, which abound in moist shady spots, love *Meconopsis*.

from Hortus Third

The Cold Weather of December 1983: A Preliminary Note

BRIAN O. MULLIGAN

The six days from December 19th through the 24th were the coldest experienced in the Puget Sound region since the winters of 1971 and 1972.* The temperature started descending on the 16th, when the maximum was 42°F. at the Arboretum and the minimum that night 32°F. It grew steadily colder each succeeding day and night, due to an influx of extremely cold air from northern Canada propelled southwards by a north wind of generally 10 to 20 mph but reaching nearly 40 mph on the 23rd and 44 mph on the 24th. The minimum temperatures recorded there on the 21st, 22nd and 23rd were 11°F., 7°F., and 10°F. respectively, then 9°F. on the 24th. The maximum on the 20th was 27°F., going down to 20°F. on the 23rd and then rising to 30°F. next day. The temperature rose abruptly to 40°F. on December 25, although freezing temperatures at night persisted through the 29th. In the northern and eastern suburbs of Seattle the minimum figures were probably several degrees lower.

The effect of this combined cold and wind on some of our broad-leaved evergreen trees and shrubs is now very obvious. Damage may take the form of partial or total dropping or discoloration of leaves, depending upon their particular location and the degree of overhead (or other) protection they had. Plants which have been affected in the Arboretum include some of the *Eucalyptus,* camellias (forms of *C. sasanqua* and some of the hybrids of *C. reticulata* and *C.* x *williamsii),* rhododendrons of the subsections *Falconera* and *Grandia, Pieris formosa* in various forms, epecially 'Cooperi', some of the larger cotoneasters, *Garrya elliptica* and the hybrid *G.* x *issaquahensis,* viburnums such as *V. atrocyaneum, V. propinquum, V. tinus* and in some sites *V. davidii,* the *Ceanothus,* as usual in these occurrences, and the younger plants of *Cistus* species and hybrids. Undoubtedly others will be noticed during the next few weeks as more detailed surveys are made.

It would be well to wait until spring—April or May—before hastily cutting off any branches or removing whole plants which appear to be dead. This is especially true for old specimens with large root systems which may possess considerable stored reserves and often make surprising recovery from apparently severe injury from cold weather.

TEMPERATURES IN THE ARBORETUM

		Max°F	Min°F
Dec.	16	42	32
	17	39	26
	18	35	28
	19	33	27
	20	27	22
	21	20	11
	22	20	7
	23	20	10
	24	30	9
	25	40	25
	26	temperature	
	27	freezing or	
	28	below at	
	29	night	

* * *

* See *Arboretum Bulletin* 35(1):23, Spring 1972 and *Arboretum Bulletin* 36(1):18, Spring 1973.

Book Reviews

WILDFLOWER GENETICS, *A field guide for British Columbia and the Pacific Northwest*, by Anthony J.F. Griffiths and Fred R. Ganders. Flight Press, Vancouver, Canada. 1983. 215 pages, freely illustrated. Paperback. Price: $9.95.

This book is a "must" for the avid amateur or professional living in the Pacific Northwest. It provides an excellent introduction to the patterns of natural variation observed in our native wildflowers and ferns. Not only are numerous examples of leaf and floral variations described and illustrated, but the basis for their origin is discussed. The book also discusses how to recognize natural hybrids and how "new" species may originate.

Wildflower Genetics provides "answers" to the most commonly asked questions about natural variation of plants of our local flora. How many times have you noticed two color forms in a single population and wondered how they originated or if they represent two distinct species? For example, in many populations of camas, both blue- and white-flowered forms co-exist. In this case, the color difference is caused by a single gene mutation and the two forms (otherwise similar) are included in the same species. The book discusses such variation and, where known, provides the genetic basis for the observations. Leaf and floral variants may not be formally recognized as a species or a variety, but they exemplify genetic differences that could set the stage for eventual morphological divergence and speciation. To remove any beliefs that such observations can never be explained, or that only professional scientists will ever understand them, the authors describe how anyone with sufficient interest can carry out simple experiments or observations that will help to explain the observed variation in nature. Understanding natural variation, at least in part, leads to an enhanced appreciation of our environment.

The book is richly illustrated, with many color and black-and-white photos and line drawings. Most of the variants in our common showy plants are discussed, including those of camas, bleeding heart, blue-eyed Mary, columbine, dogwood, kinnikinnick, maple, monkey flower, thimbleberry, and trillium. An appendix listing places to look for genetic variation in plants and a glossary are also included.

Wildflower Genetics fills a void in the wildflower book market. It is one of a kind and deserves to be widely read.

MELINDA F. DENTON

APPLES, A GUIDE TO THE IDENTIFICATION OF INTERNATIONAL VARIETIES, by John Bultitude. University of Washington Press, Seattle, Washington, 1983. Hardcover, 332 pages, 500 illustrations, 250 in color. Price: $50.00.

John Bultitude is acknowledged to be one of the world's foremost authorities on apple identification as a result of his over 30-year association with the National Fruit Trials at Brogdale Farm, Faversham, Kent, United Kingdom. Brogdale Farm has perhaps the largest collection of apple cultivars in the world. From this vast collection he has selected 252 cultivars (varieties) for classification and description with the purpose of using this text for identification of unknown cultivars which one might find in an orchard or garden.

This text is beautifully illustrated with 250 color plates of the cultivars as they appear on the tree followed by black and white cross-sectional views with brief but adequate descriptions of tree and fruit characteristics, plus references to other sources of information. This is preceded by a six-page section on apple identification with a classification of cultivars into eight groups (types) related to common cultivars with distinct characteristics (Lord Derby type, Granny Smith type, Cox's Orange Pippin type, etc.)

This is truly an international publication and therein lies its limitation as far as North American apple buffs are concerned. Of the 252 cultivars described, less than 20% are likely to be found in United States orchards and gardens. Of the 51 cultivars grown commercially in the Pacific Northwest before 1900, only 23 appear in the book. Such survivors of early commercial orchards are the ones commonly brought in to the "experts" for identification at fruit shows or local extension offices. Among those not discussed are many commonly found cultivars such as Esopus Spitzenburg, Ben Davis, Gano, Black Gilliflower, Summer Rambo, Tolman Sweet, Twenty Ounce, Yellow Transparent and Yellow Bellflower. The presence of so many cultivars never grown here and the absence of some of our common ones would make this a difficult text to use for identification in this region of the United States and probably in other areas. Furthermore, the classification based on types which may be totally foreign (Lord Derby, Lane's Prince Albert, James Grieve, Golden Noble, Worcester Pearmain, Cox Orange Pippin and Egremont Russet) may make the text of limited value as a tool for identification. In the United Kingdom and perhaps in other parts of Europe, as well as Australia and New Zealand, it should be of great value and a cherished addition to our rather scant literature in Systematic Pomology.

ROBERT A. NORTON

PRELIMINARY DIRECTORY OF LIVING PLANT COLLECTIONS OF NORTH AMERICA

The Plant Collections Committee of the American Association of Botanical Gardens and Arboreta (AABGA) is pleased to announce the first edition of the *Preliminary Directory of Living Plant Collections of North America.*

This compendium of data on the living plant collections of 58 North American botanical gardens and arboreta includes listings of documented living collections, other plant resources, management, interpretation and research on collections as well as information regarding staff, size and location of the garden.

Plant scientists and horticulturists will find this Directory a valuable reference tool. Members of plant societies, horticultural organizations and the general public with interest in particular plant collections should add the *Preliminary Directory of Living Plant Collections of North America* to their horticultural libraries.

Ordering information is available by contacting: AABGA, P.O. Box 206, Swarthmore, PA 19081. (softcover, $15.00 plus $1.00 postage & handling)

Bridge over the canyon stream at Mt. Pisgah Arboretum. **Photo: R. Love**

Blackberry Vines Root at Both Ends! Mount Pisgah Arboretum

*RHODA M. LOVE**

The Mount Pisgah Arboretum, located close to Eugene in Lane County, Oregon, is ten years old this year. The "Friends of Mount Pisgah Arboretum," incorporated in 1973, is a volunteer non-profit organization dedicated to the development of a public arboretum in Oregon's upper Willamette Valley. The Arboretum site was chosen a short time after the incorporation of the Friends, and the name of the Arboretum reflects its location. The 118-acre site lies at the base of 1520-foot Mount Pisgah, a mountain named by early Lane County pioneers who doubtless had in mind the biblical promised land. (It was from the summit of Mount Nebo of the Pisgah range, in what is now Jordan, that Moses viewed the land of Canaan. *Deuteronomy 34: 1-4)*

To date, development of the Mount Pisgah Arboretum has involved thousands of hours of volunteer labor from individuals who have not only vision, but the willingness to don work clothes to make that vision a reality.

As I was pulling blackberry vines in a fine spring drizzle at the Arboretum this morning, my mind drifted back to the days of my youth in Seattle. I had majored in botany at the University of Washington; the Arboretum there, in its lovely setting on Lake Washington, was to me one of the finest and most attractive of Seattle's public parks. It is because I have known such an Arboretum in the past that I feel so strongly today about an arboretum at Mount Pisgah—an arboretum for the enjoyment and education of future generations of Oregonians, a project worthy of strong support.

One of the first tasks that faced the volunteers at Mount Pisgah was the monumental chore of removing tons of blackberry vines and poison

*Dr. Rhoda M. Love is administrative assistant of the Mount Pisgah Arboretum.

Bark of incense cedar. Photo: R. Vorobik

Majestic incense cedars at Mt. Pisgah Arboretum.
Photo: R. Vorobik

The great meadow at Mt. Pisgah Arboretum. Photo: R. Vorobik

MOUNT PISGAH ARBORETUM

The delicate network of fishnet lichen *(Ramalina menziesii)*, one of the most spectacular lichens in the west. Lichens consist of algal cells wrapped in a layer of fungal material that provides protection from drying. In moist conditions, light can pass through the fungal layer and allow the algal cells to manufacture sugars, shared by both partners. This particular lichen is very common on oaks and coastal conifers from California to Washington. Photo: R. Vorobik

oak. These invasive shrubs had grown so vigorously in the area that they virtually obscured the topography and all but the largest and stoutest of the plants. Several years of toil were necessary before the really striking features of the site were revealed.

Once these troublesome plants were removed, construction of the marvelous network of trails and bridges could begin. A parking area and picnic area were developed and plantings were initiated. Although very few ornamental species have been planted, already we have a beautiful facility to which we are proud to invite the public. Over five miles of all-weather trails tour the Arboretum's finest areas: a lovely wooded hillside with forests of Douglas fir and incense cedar, a broad meadow dotted with centuries-old Oregon oaks, a charming lily pond near the river, and a plateau from the summit of which visitors can enjoy views of mountains, rivers and farmlands. The Arboretum's well-developed woodlands provide diverse habitats for native wildlife such as birds and deer. The spring visitor is now rewarded with a breathtaking display of Willamette Valley wildflowers.

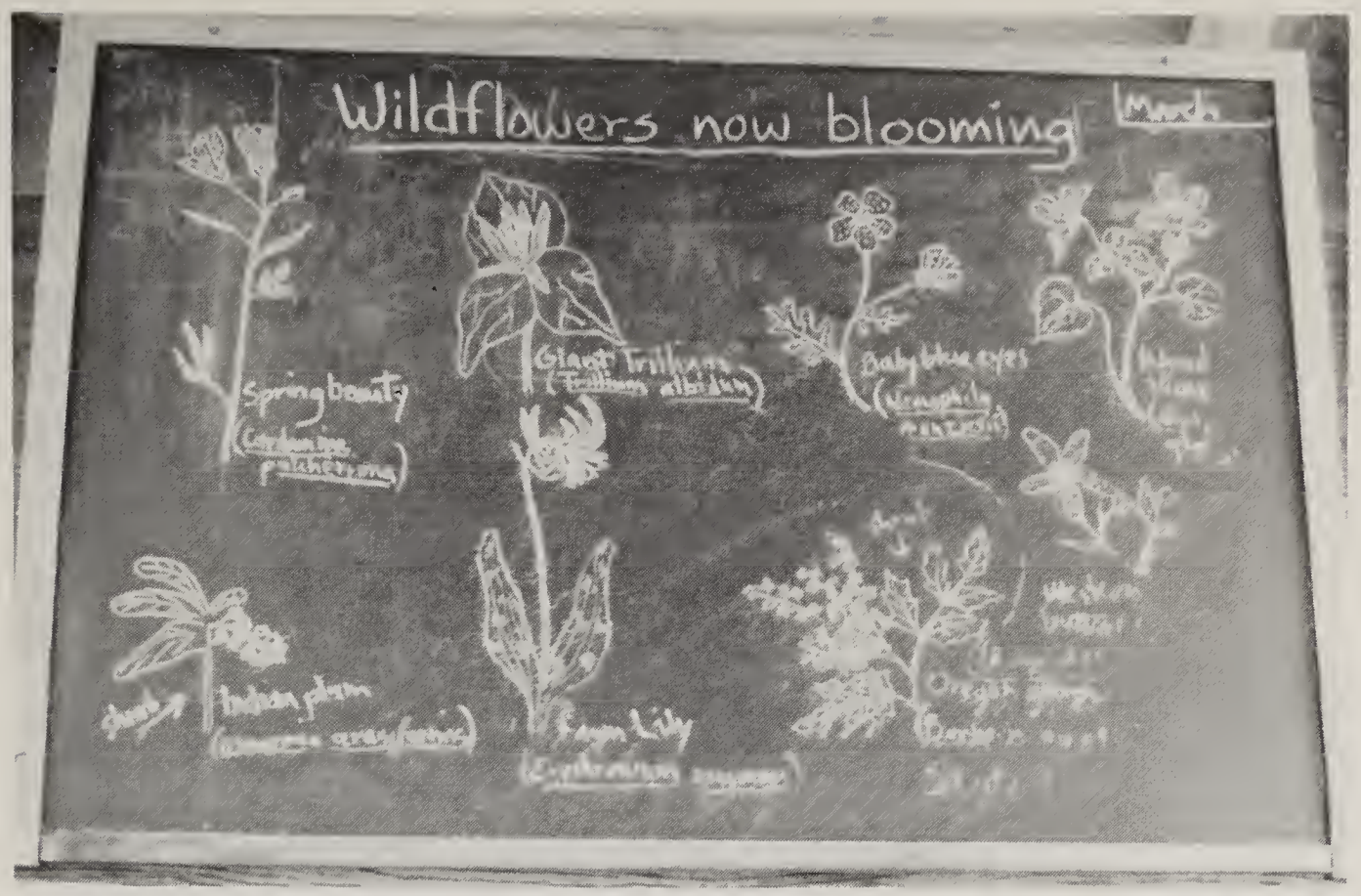
One bonus brought about by brush removal has been the flourishing of dozens of species of wildflowers. As soon as these were released from competition, they were revealed in their colorful glory. The spring visitor to the Arboretum is favored with vistas of meadows and hillsides richly carpeted with an array of blooms including buttercup, camas, delphinium, nemophila, calochortus, fawn lily, columbine and shooting star.

The Arboretum publishes a trail guide, a plant list, a bird list and a children's guide, all of which are available to visitors. In addition, we have an active education program for local grade schoolers and we host exhibits of wildflowers in the spring and of mushrooms in the fall.

The Arboretum's ultimate goal calls for planting of trees and shrubs from around the world amid a framework of native flora in such a way as to create a scattering of international groves. Rather than arranging plants around a taxonomic or structural plan, the introduction of exotic specimens will follow an ecosystem approach. We will display woody plants and perennials in a manner which will, insofar as possible, duplicate natural plant communities from diverse temperate regions of the world.

The Mt. Pisgah Arboretum has operated successfully for ten years on private local contributions. We receive no tax dollars; however we have been aided in trail-building by several summer CETA grants. The Arboretum has been generously supported by two Eugene-based charitable trusts, the Donald R. Barker Foundation and the Bowerman Foundation. Recently we have begun to contact other northwest foundations for support and we are presently conducting a vigorous fund drive. The goals of the present drive are to obtain an operating base of $150,000 to be used to develop a master landscape plan for the Arboretum. Planting of our international specimens will begin as soon as this plan is complete.

To return to the blackberries: because their vines are rooted at both ends, they are very difficult to pull. Each runner has to be clipped



Education is one of the activities at Mt. Pisgah Arboretum. **Photo: R. Love**

A beckoning woodsy tunnel at Mt. Pisgah Arboretum.
Photo: R. Love

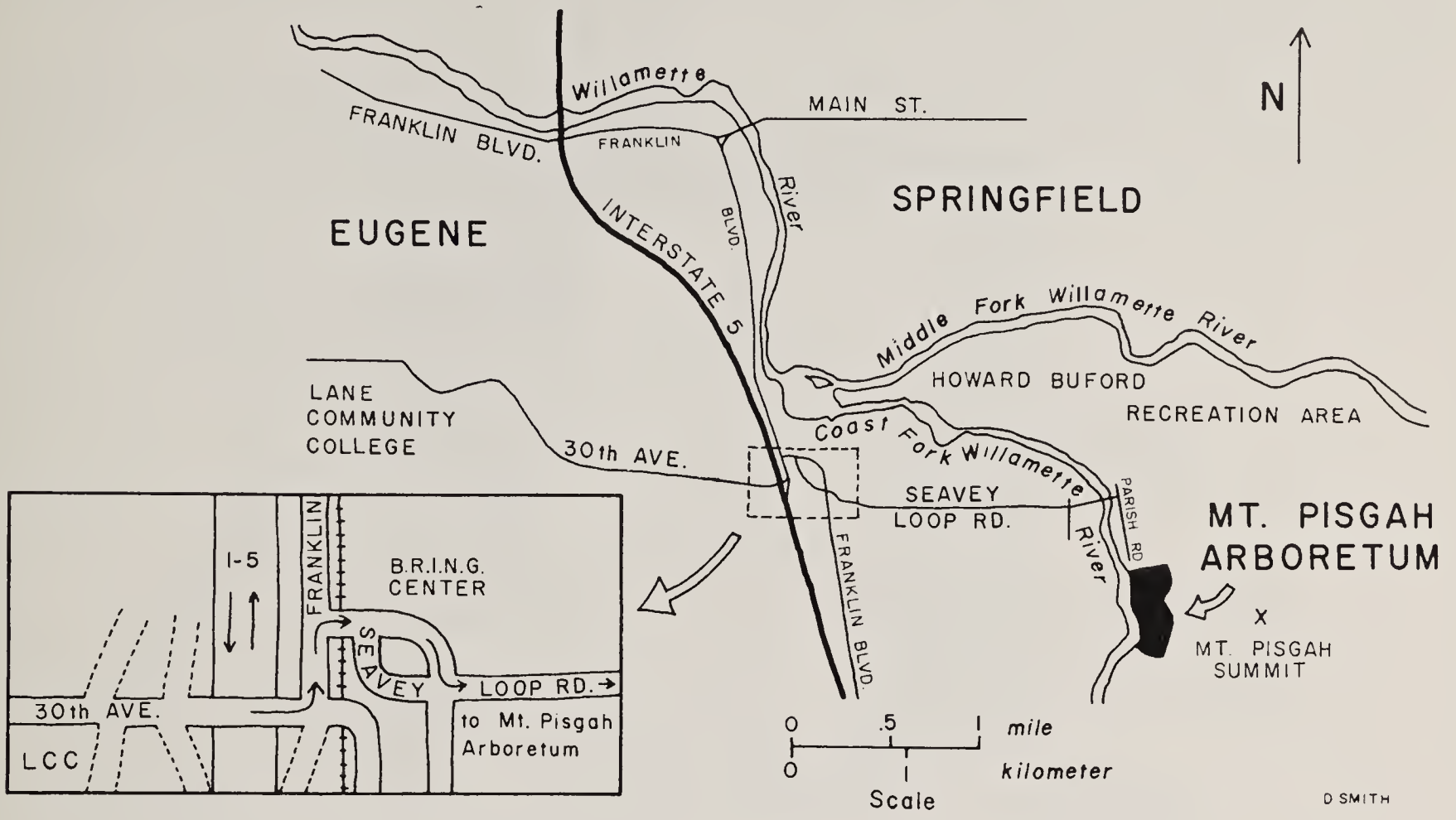
Rhoda Love, administrative assistant at Mt. Pisgah.
Photo: R. Vorobik

twice, once at the base and again where it has rooted at the tip. However the chore is a satisfying one because within days after the removal of the brambles, the wildflowers appear and bloom. My commitment and that of the other Friends of Mount Pisgah Arboretum can be compared to the stubborn blackberry vine. Rooted deep in my past in Seattle and the wonderful Arboretum there, it stretches into the future where it is likewise firmly rooted. Those of us who are involved with this project hope that our Arboretum will continue to flourish and take firm root for the enjoyment and benefit of future plantspeople.

Fruit and foliage of Indian plum, *Oemleria cerasiformis.* **Photo: R. Vorobik**

The rainy side of Mt. Pisgah, where rocks are heavily clothed in moss. **Photo: R. Vorobik**

We would like to extend an invitation to the reader to visit Mount Pisgah Arboretum, located about three miles from I-5, south of Eugene, Oregon. To reach the Arboretum, take exit 189 from I-5, proceed east on Seavey Loop Road, drive across the Coast Fork of the Willamette River and turn right into the grounds. We are open daily during daylight hours; there is no admission charge.



Classes of Interest

Urban Horticulture—Arboretum

These classes are open to the public. To register and for further information, call (206) 545-8033.

CALIFORNIA GARDEN AND WINERY TOUR
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ADVANCED CUTTINGS. Instructor: William Halstead. Techniques for rooting the more difficult woody and herbaceous plants. For those who have previous propagation experience. Saturday, February 18; 9 AM-Noon. $15 includes plants and materials.

BONSAI FOR BEGINNERS. Instructor: Jane Nelson, past president of the Puget Sound Bonsai Society. Learn the art of bonsai and begin to train your own plants. Saturdays, February 25 and March 3, 10, 17, 24 and 31; 10 AM-Noon. $35.

GREENHOUSE GARDENING. Instructor: Sue Stockton. Types of greenhouse systems, equipment and propagation in the home greenhouse are covered in this class for would-be greenhouse owners. Saturdays, February 25 and March 3 and 10; 10 AM-Noon. $20.

LANDSCAPE PRUNING. Instructor: Fred Hoyt. An intermediate-level course emphasizing renovative pruning of trees and shrubs. Includes lecture and field demonstrations. Saturdays, March 3 and 10; 10 AM-Noon. $15.

PLANTING TO ATTRACT BIRDS. Instructors: Stephen Penland and Philip Fortunato. Learn to landscape your garden to attract birds and other wildlife. Course includes a visit to a National Wildlife Federation-certified "backyard wildlife sanctuary". Tuesday, March 13 and Thursday, March 15; 7-9 PM. Saturdays, March 17 and 24; 9 AM-Noon. $30.

PLANT PHOTOGRAPHY. Instructor: Bernard Nist, well-known nature photographer. A class in photographing plants and flowers. Lecture, field sessions and follow-up critique. Thursday, March 29; 7-9 PM. Saturday, March 31; 10 AM-Noon. Critique session to be arranged. $18.

More Classes of Interest

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For complete information about these winter classes, call SPECTRUM, 543-2590.

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For registration information call 543-5592, for these winter courses.

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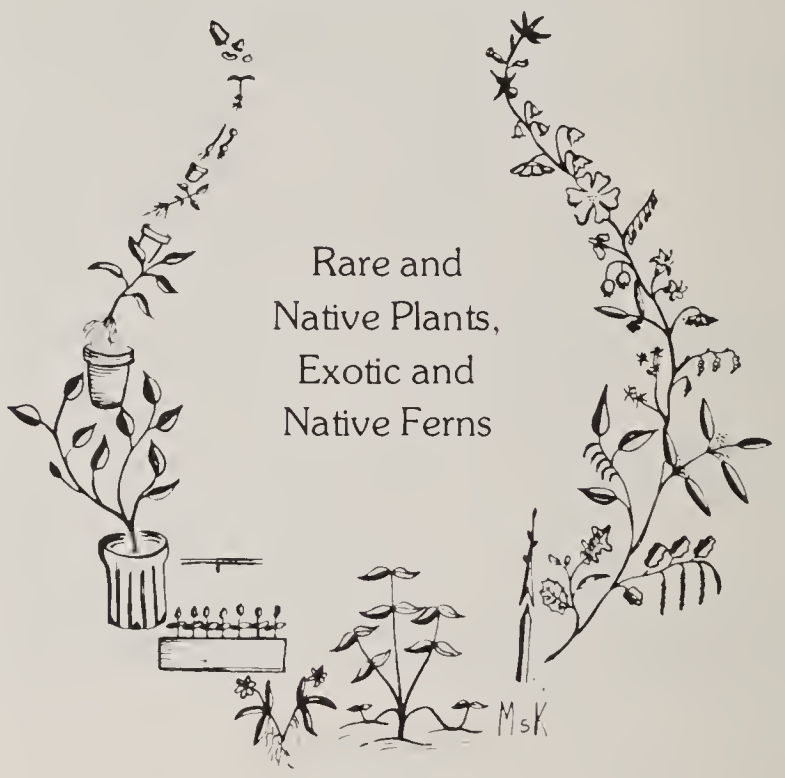

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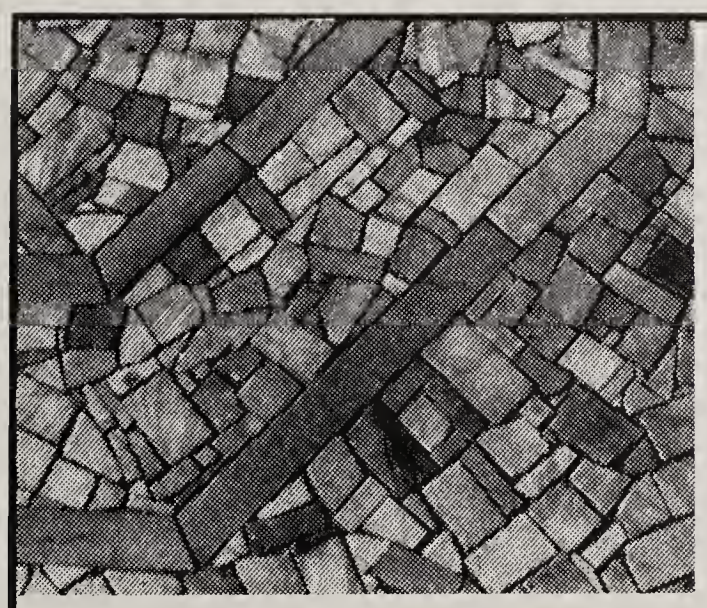

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Bracken fern, *Pteridium aquilinum.* **Photo: Tom Boyden**

VISIT YOUR ARBORETUM IN WINTER

Winter's own beauty,
and the promise of early spring
in an unfurling frond of fern.

EXPLORERS' WALKS will continue to be offered by the Arboretum Naturalist on the fourth Wednesday of each month: February 22 features "Winter Color in the Arboretum," and March 28 presents "Treasures of Early Spring." Meet at 10 AM at the Arboretum Office and wear warm clothing and adequate footgear.